The Fe Catalyst on Copper Substrates: A Way Forward for Production of Carbon Nanotube Bundles, Ropes and Other Self Assembled Structures

Pawan K. Tyagi[1], Abha Misra[1], Manoj K.Singh[1], Pradip Das[1], D. S. Misra[1@], Jay Ghatak[2], P.V. Satyam[2], F. Le Normand[3]

[1]Deaprtment of Physics, Indian Institute of Technology, Bombay, Mumbai-400076, India
[2]Institute of Physics, Bhubaneswar-751005, India
[3]Groupe Surfaces-Interfaces, IPCMS, UMR 7504, CNRS, BP 43, 67038, Strasbourg Cedex, France

Abstract

Self assembled foams and other structures of carbon nanotubes have recently been the center of interest for the scientific community[1]. These will be assembled as the new applications of the carbon nanotubes appear on the horizon. For instance, a nano-size mat of carbon nanotubes may prove to be an excellent stopper of high-energy particles. Carbon nanocages may have good application as selective filters for the proteins and other biological molecules. Self-assembled carbon tubes were grown onto iron electroplated copper foil substrates. The iron layers were treated in the plasma of ammonia (NH_3) gas for 1-3 minutes in the temperature range 250 ^{0}C – 500 ^{0}C at pressure 10 torr for the formation of nano-sized iron catalyst, which became nuclei for subsequent growth of CNTs. Methane (CH_4) and hydrogen (H_2) were used as pressure gases at 40 torr in a temperature range 700 ^{0}C-900 ^{0}C and deposition time was 3-5 minutes. The aligned multiwalled nanotube bundles, of very high purity, could be easily grown in our system[2]. For certain parameter window the nanotubes self assembled in the form of a rope bundles. Also the length of nanatubes in our case is very long with the tubes arranging to form cage like structure. The TEM, SEM, Raman and XRD studies on these structures will be presented.

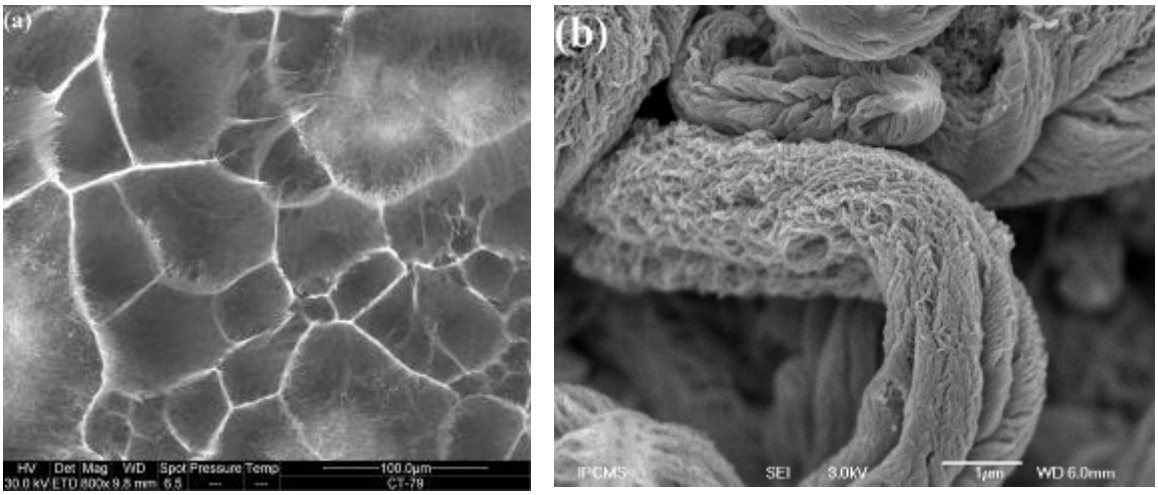

Figure1: (a) SEM (Scanning electron microscope) image of the self assemble of the carbon nanotubes (b) carbon nanotubes in the form of ropes.

Reference:

1.Nirupama Chakrapani, Bingqing Wei, Alvaro Carrillo, Pulickel M. Ajayan, and Ravi S. Kane. PNAS,**101**,4009 (2004)

2. Pawan K. Tyagi, M. K. Singh, Abha Misra, N. Kumar, D. S. Misra, E. Titus, N. Ali, J. Gracio, M. Roy and A. K. Dua. Thin Solid Films, Volumes 469-470, 127.(2004),